

*REMARKS/ARGUMENTS**The Pending Claims*

Claims 1, 4-7, 10-14, 17, 20-25, and 28-34 are currently pending. Claims 17, 20-25, and 28-34 are currently identified as withdrawn. Reconsideration of the pending claims is respectfully requested.

Amendments to the Claims

Claim 1 and 17 have been amended to recite that the composition comprises about 0.05 to about 5 mmol/kg of the metal ions, as recited in the originally filed claims 3 and 19 as well as in the specification at, for example, paragraph 0019. Claims 1, 10, 17, and 28 also have been amended to recite that the polishing composition has a pH of about 2 to about 5, as recited in originally filed claims 9 and 27 as well as in the specification at, for example, paragraph 0021. Claims 2, 3, 8, 9, 15, 16, 18, 19, 26, 27, 35, and 36 have been canceled. No new matter has been added by way of these claim amendments.

Summary of the Office Action

Claims 1-3, 7-10, and 14-16 stand rejected under 35 U.S.C. 103(a) as being obvious over U.S. Patent 6,099,604 (Sandhu et al.) in view of U.S. Patent 6,812,193 (Brigham et al.) and WO 02/26906 A1 (Beitel et al.). Claims 4, 5, 11, and 12 stand rejected under 35 U.S.C. 103(a) as being obvious over Sandhu et al. in view of Beitel et al. as applied to claims 1-3, 7-10, and 14-16 above, further in view of U.S. Patent 6,432,828 (Kaufman et al.).

Discussion of the Obviousness Rejection

For subject matter defined by a claim to be considered obvious, the office must demonstrate the differences between the claimed subject matter and the prior art “are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” 35 U.S.C. § 103(a); see also *Graham v. John Deere Co.*, 383 U.S. 1, 148 U.S.P.Q. 459 (1966). The ultimate determination of whether an invention is or is not obvious is based on certain factual inquiries including: (1) the scope and content of the prior art, (2) the level of ordinary skill in the prior art, (3) the differences between the claimed invention and the prior art, and (4) objective evidence of non-obviousness. *Id.* at 17-18.

A patent composed of several elements is not proved to be obvious merely by demonstrating that each element was, independently, known in the prior art. *KSR Int'l v. Teleflex, Inc.*, 127 S.Ct. 1727, 1731 (2007). The Supreme Court has held that, in a proper analysis, one must still “determine whether there was an apparent reason to combine the known elements in the way a patent claims.” *Id.*

1. Scope and Content of the Prior Art

Sandhu et al discloses a chemical-mechanical polishing (hereinafter “CMP”) slurry that enhances the removal of surface moieties from the surface of semi-conductor wafers comprising a solvent, abrasive particles, and at least one chelating agent (col. 2, lines 53-54). The wafer surface may be formed from a metal oxide, metal nitride, metalloid oxide, and/or metalloid nitride (col. 7, line 46-49). Sandhu teaches that the preferred substrate for its CMP slurry is one which is predominantly or only silicon oxide (col. 7, lines 59-61). Sandhu lists the abrasive particles suitable for use in the invention as alumina, silica, ceria, diamond, and silicon nitride (col. 10, lines 7-9). Sandhu also teaches the addition of metal ions as a preferred component in its CMP slurry (col. 6, lines 20-29). The metal ions may be selected from Group 2 of the Periodic Table (col. 6, lines 20-29). Sandhu does not specify the amount of metal ions to be included in a CMP slurry (col. 10, lines 11-18).

Another optional component of the Sandhu invention is the addition of a pH buffer (col. 6, lines 59-63). Sandhu teaches that the pH of the CMP slurry may be basic, neutral, or acidic depending on the composition of the surface being polished and the composition of the slurry (col. 7, lines 8-15). One of Sandhu’s examples teaches the use of a KOH-based slurry with a pH of 10-10.5 to which ethyl-enediamine is added for CMP of borophosphosilicate glass (hereinafter “BPSG”) (*see* Example 1, col. 9, lines 15-24). Another example teaches the use of ILD1300 slurry for CMP which has a pH of 11 (*see* Example 2, col. 9, lines 26-31).

Brigham discloses a CMP composition useful for polishing or planarizing copper (col. 1, lines 16-18). Brigham teaches a slurry comprising an oxidizing agent, optionally a copper corrosion inhibitor, abrasive particles, surface active agent, a source of chloride ions, and a source of sulfate ions (abstract). Brigham teaches that the preferred abrasive particles for CMP are alumina particles (col. 3, line 40). Brigham discloses a CMP slurry containing

about 0.001 to about 5 g/L of both chloride and sulfate ion sources (*see* col. 4, lines 44-48). The chloride ion source can be a chloride salt of an alkaline earth metal (*see* col. 8 lines 56-58). Brigham does not teach or suggest a pH for the CMP slurry.

The CMP composition disclosed in Brigham is designed to be highly selective towards copper (col. 2, lines 46-50). Brigham's examples illustrate increased rates of copper polishing using its invention, and all of the Brigham examples involve the use of sodium chloride and sodium sulfate as the sources of chloride and sulfate ions (col. 5, line 55, to col. 7, line 18).

Beitel discloses a method directed to CMP of platinum metals (col. 2, line 67, to col. 3, line 4). Beitel teaches the use of a CMP composition comprising abrasive particles, an oxidation agent, hydrogen peroxide, and water (col. 3, lines 18-24). A preferred embodiment of Beitel's invention includes abrasive particles of alpha-aluminum oxide (col. 4, lines 6-8). Beitel does not teach or suggest the addition of metal ions to its polishing slurry. Beitel teaches a preferred pH of 4-9 (col. 4, lines 37-40).

Kaufman discloses a CMP slurry for copper substrates comprising an oxidizing agent, a complexing agent, an abrasive, and an optional surfactant for increased the polishing rate of copper alloy, titanium, titanium nitride, tantalum, and tantalum nitrate from a substrate (abstract). Kaufman's examples illustrate increased polishing rates of copper and copper wafers having a titanium, titanium nitride, or tantalum under-layer using the disclosed slurry (Examples I-III, col. 10, line 22, to col. 12, line 67). Kaufman teaches a preferred embodiment of its CMP slurry that contains fumed alumina as an abrasive (col. 7, lines 36-38). Kaufman does not teach or suggest the addition of metal ions to its CMP slurry or the use of alpha alumina as an abrasive. Kaufman teaches or suggests a preferred pH of 5-9 and a most preferred pH of 6.5-7.5 (col. 6, lines 37-42).

2. *Level of Ordinary Skill in the Art*

For the purposes of the present argument, one of ordinary skill in the art can be treated as someone with an advanced chemistry degree and at least a few years of experience in the field of chemical-mechanical polishing of substrates.

3. *Differences Between Claimed Invention and Prior Art*

The polishing composition recited in the amended claims comprises (a) α -alumina abrasive, (b) about 0.05 to about 5 mmol/kg of calcium, strontium, and/or barium ions, and (c) water, and the polishing composition has a pH of about 2 to about 5.

Sandhu differs in many ways from the claimed invention. First, Sandhu does not disclose the use of α -alumina as an abrasive, but rather merely discloses alumina (among many other abrasives). Second, while Sandhu discloses that metal ions from Group 2 of the Periodic Table can be present in the disclosed polishing composition, Sandhu does not disclose any specific quantity of such metal ions, let alone 0.05-5 mmol/kg of such metal ions. Third, Sandhu discloses that the polishing composition can have any suitable pH rather than the particular pH of about 2 to about 5. Indeed, one of Sandhu's examples involves a polishing composition with a pH of about 10 to 11, while another of Sandhu's examples involves a polishing composition with a pH of 11.

Brigham also differs from the claimed invention in several respects. First, Brigham does not disclose the use of α -alumina as an abrasive, but rather merely discloses alumina. Second, while Brigham discloses a polishing composition with 0.001-5 g/L of chloride and sulfate ion sources and that the chloride ion source can be a chloride salt of an alkaline earth metal, Brigham does not disclose the use of 0.05-5 mmol/kg of any substance, let alone metal ions of calcium, strontium, barium, or a mixture thereof. Brigham does not teach or suggest that the polishing composition has a pH of about 2 to about 5; in fact, Brigham does not disclose any pH for its polishing composition.

Beitel discloses that the abrasive in the polishing composition can be α -alumina, while Kaufman discloses that the abrasive can be fumed alumina, which is an amorphous form of alumina rather than a crystalline form of alumina such as α -alumina. Both Beitel and Kaufman fail to disclose the use of calcium, strontium, and/or barium ions in a polishing composition, let alone in a concentration of 0.05-5 mmol/kg. Beitel and Kaufman describe that the polishing composition can have a pH of 4-9 and 5-9, respectively, i.e., a pH that is acidic, neutral, or basic, rather than a polishing composition with the particular pH of about 2 to about 5.

4. *Objective Evidence of Unobviousness*

For purposes of the present argument, Applicants have no need to refer to any objective evidence of unobviousness of the present invention as defined by the amended claims.

5. *Consideration of Graham Factors Together*

Although Sandhu discloses a polishing composition for use in polishing semiconductor wafer substrates, as indicated above, the polishing composition of Sandhu differs from the claimed polishing composition by not including α -alumina as the abrasive and 0.05-5 mmol/kg calcium, strontium, and/or barium ions and by not adjusting the pH of the polishing composition to about 2-5.

A person of ordinary skill in the art would not have considered the disclosure of Brigham when trying to improve the polishing composition of Sandhu because Brigham is not directed to the polishing of metal oxides, metal nitrides, metalloid oxides, or metalloid nitrides, e.g., silicon oxide (as in Sandhu), but rather the polishing of copper, which is quite different (*see* Brigham, col. 2, lines 46-50).

Even if a person of ordinary skill were to modify Sandhu to include the amount of chloride ion source disclosed by Brigham, the resulting composition would not necessarily be the inventive composition defined by the pending claims. First, it would be mere chance if a person of ordinary skill chose calcium, barium, or strontium chloride as a chloride ion source. Second, it would be merely accidental if the amount of calcium, strontium, or barium chloride used by a person of ordinary skill resulted in the presence of 0.05-5 mmol/kg calcium, strontium, and/or barium ions in the polishing composition as required by the pending claims.

The disclosures of Beitel and Kaufman do not cure these deficiencies of Sandhu and Brigham because Beitel and Kaufman do not teach or suggest the addition of metal ions to a polishing composition.

Moreover, Sandhu does not teach or suggest that the polishing composition should have a pH of about 2 to about 5 as recited in the pending claims. In fact, since Sandhu's

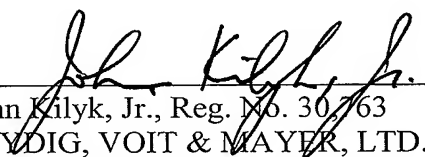
examples describe CMP slurries with a pH of about 10 to 11, Sandhu tends to teach away from a pH of about 2 to about 5. Brigham, Beitel and Kaufman either do not mention pH or disclose pH ranges that include acidic, neutral, and basic pH, such that these references would not guide a person of ordinary skill in the art to adjust the pH of the polishing composition of Sandhu to any particular pH, let alone a pH of about 2 to about 5 as recited in the pending claims.

In view of the foregoing comments concerning each of the *Graham* factors, Applicants respectfully submit that the subject matter defined by the pending claims is unobvious over Sandhu in view of Brigham, Beitel, and Kaufman such that the obviousness rejection should be withdrawn.

Conclusion

Applicants respectfully submit that the patent application is in condition for allowance. If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

Respectfully submitted,



John Kilyk, Jr., Reg. No. 30,763
LEYDIG, VOIT & MAYER, LTD.

Two Prudential Plaza, Suite 4900
180 North Stetson Avenue
Chicago, Illinois 60601-6731
(312) 616-5600 (telephone)
(312) 616-5700 (facsimile)

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